

REMARKS

In response to the Final Office Action mailed February 3, 2003 (hereinafter "the Office Action"), and the Request for Continued Examination (RCE) submitted herewith, Applicant respectfully requests reconsideration.

Claims 1-18 and 27-34 are pending in this application. Claims 20-26 were canceled in a prior response, claim 19 has been canceled herein, and claims 31-34 are newly presented.

Claims 1, 6-9, 11-12, 17, and 27-30 have been amended herein. The amendments to independent claims 1, 12, 17, and 27 and dependent claims 28-30 are described in further detail below. The amendments to dependent claims 6-9 and 11 are not intended to substantively affect the scope of these claims, but rather to further clarify the language of these claims by referring to the "conductive layer" as "said at least one conductive layer" as set forth in claim 1.

Telephone Interview With Examiner Munson

The undersigned thanks Examiner Munson for the courtesies extended to him during the telephone interview on May 8, 2003. The substance of this telephone interview is summarized below.

During the telephone interview, the claim rejections under 35 U.S.C. §102 and 35 U.S.C. §103 were discussed in general terms. Examiner Munson stated that although the claims did recite an interference filter, the interference filter was described as including an insulating layer and a conducting layer, and there was no further recitation of how those two layers were used to create an interference filter. Examiner Munson indicated that if there were some further structural limitations (e.g., relating to the thickness or structural composition of the layers), or limitations directed to how the recited layers function to create an interference filter, he believed that would help to distinguish the claims over the various cited references. Although no substantive agreement was reached with respect to the claims, Examiner Munson indicated he would be willing to further discuss this application in more detail after the filing of an RCE and prior to a new Office Action on the merits.

Also briefly discussed during the telephone interview was the Examiner's interpretation of Fig. 2 in Kioke, wherein the Examiner asserted that the various red, green, and blue arrays extended into and out of the page, and thus were common to a particular sub-array.

Claim Rejections Under 35 U.S.C. §112

Claims 28-30 stand rejected under 35 U.S.C. §112, first and second paragraphs. Claims 28-30 have been amended to overcome this rejection and are now in agreement with Applicant's specification and Fig. 2C. Specifically, as shown in Fig. 2C, the insulating layer 4-3 is common to three photodiodes, each in different sub-arrays, the insulating layer 4-2 is common to two of the three photodiodes, and the insulating layer 4-1 extends across only one of the three photodiodes, with the thickness of the insulating layers being different in each sub-array to interferentially filter a particular color or wavelength of light.

In light of the amendments to claims 28-30, it is respectfully requested that the rejection of claims 28-30 under 35 U.S.C. §112, first and second paragraphs be withdrawn.

Claim Rejections Under 35 U.S.C. §102 and 35 U.S.C. §103

Claims 1-19 and 27-30 stand rejected over a variety of references including Kioke (U.S. Patent No. 4,242,694), Nagasaki (U.S. Patent No. 5,502,488), Motojima (U.S. Patent No. 4,996,578), Baji (U.S. Patent No. 4,407,010), Merrill (U.S. Patent Nos. 6,150,683, 5,614,744, and 6,160,282, hereinafter Merrill '683, Merrill '744, and Merrill '282, respectively), and Nagano (U.S. Patent No. 6,049,118), all previously of record. With respect to the independent claims (claims 1, 12, 17, 19, and 27), independent claims 1, 12, and 17 are rejected under 35 U.S.C. §103 over Kioke and under 35 U.S.C. §102 over Nagasaki, claim 19 is rejected under 35 U.S.C. §102 over Baji or Merrill ('683 or '282 or '744), claims 12, 17, and 27 are rejected under 35 U.S.C. §102 over Motojima, and claim 27 is rejected under 35 U.S.C. §103 over the combination of Kioke and Merrill '744.

Each of independent claims 1, 12, 17 and 27 has been amended to further clarify what is meant by the term "interference filter." For example, independent claim 1 has been amended to recite that the determined thickness of said at least one insulating layer and said at least one conductive layer coating the respective sub-array determine the respective color of light that is interferentially filtered and provided to the respective sub-array. Each of independent claims 12, 17, and 27 has been amended to recite that the predetermined thickness of said at least one insulating layer, in combination with said conductive layer, is adapted to interferentially filter a

particular wavelength of light. As described in further detail below, by further clarifying the manner in which light is interferentially filtered by the interference filter, each of these claims patentably distinguishes over the asserted references.

1. The Subject Matter of Claim 1

Claim 1, as now presented, is directed to an array of photodiodes made of regions of a second conductivity type formed in a semiconductive region of a first conductivity type. The array of photodiodes is divided into three interleaved sub-arrays, each sub-array corresponding to a respective color of light. All photodiodes of a same sub-array are coated with a same interference filter including at least one insulating layer of determined thickness coated with at least one conductive layer, with the determined thickness of the at least one insulating layer and the at least one conductive layer coating the respective sub-array determining the respective color of light that is interferentially filtered and provided to the respective sub-array. The at least one conductive layer is electrically connected to the semiconductive region of the first conductivity type.

Claim 1 stands rejected under 35 U.S.C. §103 over Kioke and under 35 U.S.C. §102 over Nagasaki. These rejections are respectfully traversed.

A. The Rejection of Claim 1 Under 35 U.S.C. §103 Over Kioke

According to the Office Action, despite the fact that Kioke does not disclose at least one conductive layer that is electrically connected to the semiconductive region of the first conductivity type as recited in claim 1, the Office Action asserts that it “would have been obvious to have the substrate 1 at ground potential and the electrodes 13 (Fig. 2) either connected to the substrate 1 or via a fixed potential (claim 2).” As noted in Applicant’s previous response mailed December 27, 2002, no support for the assertion that it would be obvious to have the electrodes 13 connected to the substrate 1 is provided in the Office Action or in Kioke, nor does the Office Action provide any motivation for this modification. Indeed, in the passages of Kioke cited in the Office Action, Kioke simply states that the “conductive films 6R and 6G” are fixed at a “predetermined voltage,” but nowhere does Kioke disclose, teach or suggest that those films are or should be electrically connected to the substrate 1. Moreover, this sole discussion in

Kioke is with reference to Fig. 1A, and not Fig. 2 as asserted in the Office Action. Accordingly, the Examiner is again respectfully requested to provide some basis for the assertion that it would have been obvious to have the electrodes 13 (Fig. 2) "connected to the substrate 1," or withdraw the rejection of claim 1 based thereon.

Even if the Office Action were to provide some basis of record for the above assertion, claim 1, as amended herein, patentably distinguishes over Kioke. Specifically, nowhere does Kioke disclose, teach, or suggest an array of photodiodes wherein each respective sub-array is coated with an interference filter including at least one insulating layer of determined thickness coated with at least one conductive layer, and wherein the determined thickness of the at least one insulating layer and the at least one conductive layer coating the respective sub-array determines the respective color of light that is interferentially filtered and provided to the respective sub-array.

As discussed in Applicant's previous response, although Kioke discloses a number of different embodiments of a solid state imaging device, Kioke clearly discloses that the optical filter 101 which separates the image of an object into color components:

- 1) is not shown in Figs. 1A, 1B, or 1D-1H, or any of Figs. 2-7;
- 2) is not formed by the silicon oxide layers 12R, 12G, and 12B and the polysilicon layer 13 shown in Fig. 2; and
- 3) operates by the absorption of light, and not the interference of light. (See Kioke, col. 3, lines 39-44; col. 7, lines 13-14; col. 7, line 54; col. 8, line 24; col. 8, lines 52-53; and col. 9, lines 46-47 describing that the optical filter 101 of Kioke is not shown in Fig. 2 or any of Figs. 1A, 1B, 1D-1H and 3-7 and is distinct from the silicon oxide layers 12R, 12G, and 12B and the polysilicon layer 13 shown in Fig. 2. See col. 3, lines 39-50 identifying that the optical filter 101 is an absorption filter and not an interference filter.) Further, nowhere does Kioke disclose or suggest that the determined thickness of the at least one insulating layer and the at least one conductive layer coating a respective sub-array determines the respective color of light that is interferentially filtered and provided to the respective sub-array as now recited in claim 1.

Accordingly, because Kioke does not disclose, teach, or suggest all the limitations recited in claim 1, and because the Office Action provides no support or motivation for the asserted

modification of Kioke, the rejection of claim 1 under 35 U.S.C. §103 over Kioke should be withdrawn.

B. The Rejection of Claim 1 Under 35 U.S.C. §102 Over Nagasaki

The Office Action asserts that Figures 1 and 3 of Nagasaki disclose an “interference filter” including “insulating” layer 4 and “conductive” layer 9 or 21. However, nowhere does Nagasaki disclose, teach, or suggest that the insulating layer 4 and the conductive layer 9 or 21 form an interference filter, or that they form an interference filter wherein the determined thickness of the at least one insulating layer and the at least one conductive layer coating a respective sub-array determines the respective color of light that is interferentially filtered and provided to the respective sub-array as now recited in claim 1. Indeed, nowhere does Nagasaki even discuss color filtering. Accordingly, claim 1 patentable distinguishes over Nagasaki and the rejection of claim 1 under 35 U.S.C. §103 over Nagasaki should be withdrawn.

Claims 2-11 depend either directly or indirectly from claim 1 and patentably distinguish over Kioke and Nagasaki for at least the same reasons.

2. The Subject Matter of Claim 12

As now presented, claim 12 is directed to a photodiode comprising a semiconductor substrate of a first conductivity type, a semiconductive region of a second conductivity type formed in the semiconductor substrate, and a multilayer interference filter disposed over the semiconductive region. The multilayer interference filter includes at least one insulating layer having a predetermined thickness, and a conductive layer disposed over the at least one insulating layer. The conductive layer includes a conductive portion that electrically connects the conductive layer to the semiconductor substrate of the first conductivity type, and the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light.

Claim 12 stands rejected under 35 U.S.C. §103 over Kioke and under 35 U.S.C. §102 over Nagasaki. Claim 12 also stands rejected under 35 U.S.C. §102 over Motojima. These rejections are respectfully traversed.

A. The Rejection of Claim 12 Under 35 U.S.C. §103 Over Kioke

As noted above with respect to the rejection of claim 1, no support is provided in the Office Action, or in Kioke, for the assertion that it would have been obvious to have the electrodes 13 (Fig. 2 of Kioke) connected to the substrate 1. Nowhere does Kioke teach or suggest such a connection, and no other basis of record has been provided for this assertion. Accordingly, the Examiner is respectfully requested to provide some basis to support this assertion or withdraw the rejection of claim 12 based thereon.

Further, claim 12 patentably distinguishes over Kioke for many of the same reasons detailed above with respect to claim 1. Specifically, nowhere does Kioke disclose, teach, or suggest a multilayer interference filter that includes at least one insulating layer having a predetermined thickness, and a conductive layer disposed over the at least one insulating layer, wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light. Accordingly, because Kioke does not disclose, teach, or suggest all the limitations recited in claim 12, and because the Office Action provides no support or motivation for the asserted modification of Kioke, the rejection of claim 12 under 35 U.S.C. §103 over Kioke should be withdrawn.

B. The Rejection of Claim 12 Under 35 U.S.C. §102 Over Nagasaki

Claim 12 also patentably distinguishes over Nagasaki for many of the same reasons discussed above with respect to claim 1. Specifically, as discussed above with respect to claim 1, nowhere does Nagasaki disclose, teach, or suggest that the insulating layer 4 and the conductive layer 9 or 21 form an interference filter, or that they form an interference filter wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light as now recited in claim 12.

Accordingly, because Nagasaki very clearly does not disclose, teach, or suggest a photodiode that includes a multilayer interference filter as recited in claim 12, the rejection of claim 12 under 35 U.S.C. §102 over Nagasaki should be withdrawn.

C. The Rejection of Claim 12 Under 35 U.S.C. §102 Over Motojima

Claims 12 also stands rejected under 35 U.S.C. §102 over Motojima. The Office Action asserts that Figure 5 of Motojima discloses an interference filter including insulating layer 6₂ and conductive layer 4, with the conductive portion including wiring 5a.

Although the Office Action asserts that Motojima discloses an interference filter, no support for this assertion is provided in Motojima. Specifically, nowhere in the disclosure of Motojima is there even a mention of an “interference filter,” nor any support for the assertion that insulating layer 6₂ and conductive layer 4 operate to form a multilayer interference filter as recited in claim 12. Further, with respect to page 5 of the Office Action and the assertion that Motojima “need not mention the words ‘interference filter,’ because this application is for a patent not a copyright,” Applicant respectfully points out that the rejection of claim 12 is based upon 35 U.S.C. §102. As noted in the MPEP “for anticipation under 35 U.S.C. 102, the reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present.” (MPEP Section 706.02, page 700-121 Rev. 1, Feb. 2003, emphasis added). The rejection of claim 12 does not satisfy this standard.

An interference filter operates by reflecting colors other than the color that is desired to be transmitted by the filter. No such properties of the various layers 6₂ and 4, such as their thickness or their refractive index are even addressed in Motojima. Clearly, nowhere does Motojima disclose, teach, or suggest that the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light as now recited in claim 12. Accordingly, because Motojima does not disclose, teach, or suggest a photodiode that includes a multilayer interference filter as now recited in claim 12, the rejection of claim 12 under 35 U.S.C. §102 over Motojima should be withdrawn.

Claims 13-16 depend either directly or indirectly from claim 12 and patentably distinguish over Kioke, Nagasaki, and Motojima for at least the same reasons.

3. The Subject Matter of Claim 17 .

Claim 17, as now presented, is directed to a photodiode comprising a semiconductor substrate of a first conductivity type, a semiconductive region of a second conductivity type

formed in the semiconductor substrate, and a multilayer interference filter disposed over the semiconductive region. The multilayer interference filter includes at least one insulating layer having a predetermined thickness and a conductive layer disposed over the at least one insulating layer. The photodiode further comprises means defining a conductive portion that electrically connects the conductive layer to the semiconductor substrate of the first conductivity type, wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light.

Claim 17 stands rejected under 35 U.S.C. §103 over Kioke and under 35 U.S.C. §102 over Nagasaki and Motojima. These rejections are respectfully traversed.

A. The Rejection of Claim 17 Under 35 U.S.C. §103 Over Kioke

As noted above with respect to the rejection of claims 1 and 12, no support for the assertion that it would have been obvious to have the electrodes 13 (Fig. 2) connected to the substrate 1 is provided in the Office Action or in Kioke. Accordingly, the Examiner is respectfully requested to provide some basis for this assertion or withdraw the rejection of claim 17 based thereon.

Further, claim 17, as now presented, patentably distinguishes over Kioke for many of the same reasons detailed above with respect to claims 1 and 12. Specifically, nowhere does Kioke disclose, teach, or suggest a multilayer interference filter that includes at least one insulating layer having a predetermined thickness, and a conductive layer disposed over the at least one insulating layer, wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light. Accordingly, because Kioke does not disclose, teach, or suggest all the limitations recited in claim 17, the rejection of claim 17 under 35 U.S.C. §103 over Kioke should be withdrawn.

B. The Rejection of Claim 17 Under 35 U.S.C. §102 Over Nagasaki

Claim 17 also patentably distinguishes over Nagasaki for many of the same reasons discussed above with respect to claims 1 and 12. Specifically, nowhere does Nagasaki disclose, teach, or suggest that the insulating layer 4 and the conductive layer 9 or 21 form an interference

filter, or that they form an interference filter wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light as now recited in claim 17. Accordingly, the rejection of claim 17 under 35 U.S.C. §102 over Nagasaki should be withdrawn.

C. The Rejection of Claim 17 Under 35 U.S.C. §102 over Motojima

Claim 17 also patentably distinguishes over Motojima for many of the same reasons discussed above with respect to claim 12. Specifically, nowhere in the disclosure of Motojima is there even a mention of an “interference filter,” nor any support for the assertion that insulating layer 6₂ and conductive layer 4 operate to form a multilayer interference filter, wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light as now recited in claim 17. Accordingly, because Motojima does not disclose, teach, or suggest a photodiode that includes a multilayer interference filter as recited in claim 17, the rejection of claim 17 under 35 U.S.C. §102 over Motojima should be withdrawn.

Claim 18 depends from claim 17 and patentably distinguishes over Kioke, Nagasaki, and Motojima for at least the same reasons.

4. The Subject Matter of Claim 27

Claim 27, as now presented, is directed to a photodiode comprising a semiconductor substrate of a first conductivity type, a semiconductive region of a second conductivity type formed in the semiconductor substrate, and a multilayer interference filter disposed over the semiconductive region. The multilayer interference filter includes at least one insulating layer having a predetermined thickness, and a conductive layer disposed over the at least one insulating layer. The semiconductor substrate defines a well formed in a base substrate of the second conductivity type, with the conductive layer being electrically connected to the base substrate, and the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light.

Claim 27 stands rejected under 35 U.S.C. §103 over Kioke and Merrill ('744), and under 35 U.S.C. §102 over Motojima. These rejections are respectfully traversed.

A. The Rejection of Claim 27 Under U.S.C. §103 Over Kioke and Merrill '744

With respect to the rejection under §103, neither Kioke nor the Office Action provides any support of record for the asserted modification of Kioke. Further, as discussed above, Kioke clearly states that the silicon oxide layers 12R, 12G, 12B, and polysilicon layer 13 in Fig. 2 form no part of the optical filter 101. Moreover, the optical filter described in Kioke is an absorption filter and not a multilayer interference filter, and Merrill '744 does not cure this deficiency. Further, nowhere does Kioke disclose, teach, or suggest a multilayer interference filter that includes at least one insulating layer having a predetermined thickness, and a conductive layer disposed over the at least one insulating layer, wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light as now recited in claim 27. Accordingly, because Kioke does not disclose, teach, or suggest all the limitations recited in claim 27, and because Merrill '744 does not cure those deficiencies, the rejection of claim 27 under 35 U.S.C. §103 over Kioke in view of Merrill '744 should be withdrawn.

B. The Rejection of Claim 27 Under U.S.C. §102 Over Motojima

With respect to the rejection of claim 27 under 35 U.S.C. §102 over Motojima, Applicant has already described how Motojima fails to disclose, teach or suggest an interference filter, let alone a multilayer interference filter as recited in claim 27. Specifically, nowhere in the disclosure of Motojima is there even a mention of an "interference filter," nor any support for the assertion that insulating layer 6₂ and conductive layer 4 operate to form a multilayer interference filter, wherein the predetermined thickness of the at least one insulating layer, in combination with the conductive layer, is adapted to interferentially filter a particular wavelength of light as now recited in claim 27. Accordingly, because Motojima does not disclose, teach, or suggest a photodiode that includes a multilayer interference filter as recited in claim 27, the rejection of claim 27 under 35 U.S.C. §102 over Motojima should be withdrawn.

5. Claims 28-30

Claims 28-30 depend either directly or indirectly from claim 1 and further patentably distinguish over Kioke and Nagasaki for reasons in addition to claim 1. Specifically, even if the silicon oxide layers 12R, 12G, and 12B, and the polysilicon layer 13 of Kioke could be read on the “interference filter” recited in claim 1 as asserted in the Office Action, there is no insulating layer that extends across three photodiodes each in a different one of the three interleaved sub-arrays as recited in claims 28-30. Instead, as clearly described in Kioke, after the second oxide film 3' is formed over the surface of the substrate, the conductive film 6 (Fig. 1G, but film 13 in Fig. 2) is provided on the second oxide film 3', and then the conductive “film or material is removed so as to leave its region overlying the photodiode.” (Col. 6, lines 41-50.) Thus, as illustrated in Figs. 1, 1G, 1H, and Figs. 2-6 of Kioke, there is no insulating layer that extends across three photodiodes each in a different one of the three interleaved sub-arrays, as the conductive films 6, 13, 14, 15, 16, 23, and 25 of Kioke are unique to each sub-array.

With respect to Nagasaki, nowhere does Nagasaki disclose, teach, or suggest that the insulating layer 4 extends across two or more photodiodes each in different sub-arrays. Accordingly, each of claims 28-30 is believed to patentably distinguish over Koike and Nagasaki for reasons in addition to claim 1 from which these claims directly or indirectly depend.

6. Claims 31-34

Newly presented claims 31-34 respectively depend from one of claims 1, 12, 17, and 27. Support for the subject matter of these claims is provided, for example, at page 2, line 25 through page 3, line 18 of Applicant's specification. Each of these claims further patentably distinguishes over the cited references for reasons in addition to the independent claim from which it depends.

For example, claim 31 recites that the at least one conductive layer of the interference filter coating the respective sub-array determines the color of light that is interferentially filtered and provided to the respective sub-array and increases the capacitance of each of the photodiodes of the respective sub-array. This double function of both participating in the color filtering of light and increasing the capacitance of each photodiode is not disclosed, taught, or suggested in any of the cited references. Indeed, none of the cited references even discloses an interference

filter, let alone an interference filter that includes at least one conductive layer that determines the color of light that is interferentially filtered and provided to a respective sub-array and increases the capacitance of each of the photodiodes of the respective sub-array as recited in claim 31. Accordingly, claim 31 patentably distinguishes over the cited references for reasons in addition to claim 1.

Claims 32-34 further patentably distinguish over the cited references for reasons similar to those discussed above with respect to claim 31.

CONCLUSION

In view of the foregoing amendments and remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes, after this amendment, that the application is not in condition for allowance, the Examiner is requested to call the Applicant's attorney at the number listed below.

If this response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicant hereby requests any necessary extension of time. If there is a fee occasioned by this response, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to deposit account No. 23/2825.

Respectfully submitted,

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